

Office of Research Facilities Development and Operations
Division of Facilities Planning



CAD Deliverable Standards

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The Basics

1.1 Purpose

This Standard has been developed for all building infrastructure disciplines and is intended for all architects, engineers, contractors, Computer Aided Design (CAD) operators, customers, and associates involved in the creation and revision of drawings at NIH, henceforth referred to as contractor. It sets mandatory, procedures for CAD drawings and Space Assignment plans. Adherence to the Standard allows for the intelligence contained within the drawings to be readily transferred to the data systems used by NIH.

The purposes of this CAD standard are as follows:

- Consistent Drawings
- Source of data for leasing and rent
- Data for space planning
- Operation and maintenance data
- Record drawings for renovation and expansion

1.2 Applicability

These standards are applicable to all NIH drawing types for all NIH facilities. There are two major categories of NIH drawings. These are project drawings and facility drawings.

1.2.1 Drawing Types

Project drawings are created for a specific project (whether construction or tenant build out) that has a definitive beginning and end. Design intent drawings would fall under the category of project drawings. Once the project is complete, the drawings are updated to reflect as-built conditions and to incorporate amendments and change orders. However, the drawings themselves are a record of past events essentially becoming history. Applicable portions of project drawings will be used to update facility drawings.

Facility drawings reflect the current condition of a building or facility, and by their very nature are living documents that are continually updated. "Intelligent" facility drawings are the primary means of transferring facility data into NIH computer integrated applications such as Computer Aided Facilities Management (CAFM) and Computer Maintenance Management Software (CMMS). After a project is complete and record drawings have been provided, the Project Officer is responsible for incorporating changes into facility drawings. This will typically be accomplished by including the facility drawing revision in the Architect and Engineering firm's scope of work.

Space Assignment drawings are a specific type of facility drawing conveying occupancy information. When NIH requests submission of assignment drawings and data, contractors must follow the direction given by the *Space Assignment Drawing Guide*.

1.2.2 Variances

No variances to this standard are allowed unless approved by NIH. The project officer shall submit an electronic Variance Request and maintain a record of all approved variances and include them with the final submittal. Procedures for submitting a Variance Request can be found in the NIH Standard Operating Procedures.

1.3 Accuracy

Contractors are responsible for the accuracy of all CAD drawings delivered to NIH. For all drawing entities all lines meet at intersections, straight lines are straight, and blocks are inserted properly without overlap. NIH may provide contractors with existing CAD drawings for convenience.

1.4 Ownership

The Government, for itself and such others as it deems appropriate, will have unlimited rights to all information and materials developed under contract and furnished to the Government. This includes any documentation thereof, reports and listings, and all other items pertaining to the work and services. Unlimited rights under this contract are rights to use, duplicate, or disclose data and information, in whole or in part, in any manner and for any purpose whatsoever without compensations to or approval from the contractor. The Government will, at all reasonable times have the right to inspect the work and will have access to and the right to make copies of the above-mentioned items. All digital files, associated data, and other products generated under the contract shall become the property of the Government.

1.5 Dissemination of Sensitive Documents

NIH and the Federal Government are concerned with the safety and security of persons and property under their control. The contractor should ensure that reasonable care is provided to protect sensitive information, both in paper and electronic format, regarding building drawings and specifications for design, construction and/or renovation, security equipment and installation, and contract guard information related to NIH-controlled facilities from being used for illegal purposes. Contractors in providing information shall always follow the following three principles:

1. Only give information to those who have a need to know.
2. Keep records of who received the information.
3. Safeguard the information during use.

All correspondence and transmittals shall be logged for tracking purposes. The log shall be submitted to the project officer at the end of a project. Emails with attachments should be treated as transmittals and saved in the specified project location.

The contractor shall keep track of who receives the information and shall request all the original documents plus the possible copies made by the receiver to be returned to the contractor for ultimate delivery or destruction of documents.

A list of all parties receiving the information shall be provided to the NIH Project Officer, and the list shall be updated anytime a new team member is added.

Paper/Hard copy progress documents may be destroyed when they are no longer applicable. The contractor shall keep a copy of required submittals for future reference and prior to complete close out of the project.

After complete closeout, other than the required set of documents for the government, all other hard copy and electronic copies of document shall be destroyed. A disclaimer form will be signed by the A/E to confirm complete compliance with NIH security procedure for documents.

1.5.1 Sheet File Security Imprint

All building plans, drawings, and specifications prepared for construction or renovation, and/or security services, either in electronic or paper formats, shall have included on each sheet file of the construction drawings or plans in a size appropriate for the sheet typically a minimum of 14 point bold face type (3 mm or about 1/8"):

**PROPERTY OF THE UNITED STATES GOVERNMENT
FOR OFFICIAL USE ONLY
Do not remove this notice
Properly destroy documents when no longer needed**

1.5.2 Cover Sheet Security Imprint

The following paragraph will be noted on the cover page of all drawing sets and on the cover page of the specifications in a minimum of 14 point bold face type (3 mm or about 1/8"):

**PROPERTY OF THE UNITED STATES GOVERNMENT, COPYING, DISSEMINATION, OR
DISTRIBUTION OF THESE DRAWINGS, PLANS OR SPECIFICATIONS TO UNAUTHORIZED
PERSONS IS PROHIBITED**

**Do not remove this notice
Properly destroy documents when no longer needed**

1.6 File Formats

1.6.1 Drawings

All drawings shall be drawn and created using the latest version of Autodesk products including but not limited to Architectural Desktop and associated Autodesk Building Systems software. Drawings shall be in compliance with latest international standard classification IFC. All drawings shall be readable *.DWG files. In addition to all other requirements noted in this documents, all projects with a construction cost of over ten million dollars shall be drawn using Building Information Modeling software with underlying database. Being "readable" is constituted by the ability to open a file without any errors, such as proxy, font substitution, xref resolution, etc., and the objects, layers, etc. in the file remaining intact. The contractor shall be responsible for software and data upgrades throughout the contract lifecycle.

1.6.2 Other Formats

Other Graphics may be submitted in *.TIF, *.GIF, *.JPG, *.CALS, *.PDF or *.BMP file format only. This option is intended for photos, conceptual sketches, etc., and not as an indication that raster file drawings will be accepted in lieu of Autodesk Architectural Desktop files. When a hard copy drawing in the drawing set includes photographs or other images the electronic file submission shall include a corresponding Autodesk Architectural Desktop *.DWG sheet file containing these raster images as xrefs or embedded files.

1.6.3 Third Party Software

A Variance Request must be submitted to the NIH Project Officer and permission granted in order to submit electronic data in a format other than those specifically named above. When it is considered in the best interest of the NIH, the Project Officer may permit third party or add-in software provided files meet requirements of Section 1.6.2. Any third party software used that modifies or creates layers in Autodesk Architectural Desktop drawings shall adhere to the AIA CAD Layering Guidelines.

1.7 Additional Information

1.7.1 Acronyms

A/E	Architectural/Engineering
AEC	Architects, Engineers, Contractors
AIA	American Institute of Architects
ANSI	American National Standards Institute
BOMA	Building Owners and Managers Association
CAD	Computer Aided Design
CAFM	Computer Aided Facility Management
CIFM	Computer Integrated Facility Management
CMM	Computerized Maintenance Management
CSI	Construction Specifications Institute
DWG	File extension for Autodesk® Architectural Desktop drawings
DWT	File extension for Autodesk® Architectural Desktop template drawings
FM	Facility Management
GSA	General Services Administration
IAI	International Alliance for Interoperability
NCS	<i>U.S. National CAD Standard</i>
NIBS	National Institute of Building Standards
PBS	Public Building Service
UDS	Uniform Drawing System
XREF	Externally referenced.

1.7.2 Addresses of Referenced Organizations

American Institute of Architects (AIA) (<i>CAD Layer Guidelines, Architectural Graphic Standards</i>) Info Central (800) AIA-3837 Internet http://www.aia.org	The Construction Specifications Institute (CSI) (<i>Uniform Drawing System</i>) Voice (800) 689-2900 Internet http://www.csinet.org
American National Standards Institute (ANSI) Voice (212) 642-4900 Internet http://www.ansi.org	International Alliance for Interoperability (IAI) (<i>Object Technology</i>) Internet http://iaiweb.lbl.gov
Building Owners and Managers Association (BOMA) Voice (202) 408-2662 Internet http://www.boma.org	National Institute of Building Sciences (NIBS) (<i>Metric Guide for Federal Construction, U.S. National CAD Standard</i>) Internet http://www.nibs.org
The CADD/GIS Technology Center for Facilities, Infrastructure, and Environment (<i>Symbols, Tri-Service Plotting Guidelines</i>) U.S. Army Engineer Research and Development Center Internet http://tsc.wes.army.mil	U.S. Coast Guard Civil Engineering Technology Center (CETC) (<i>Tri-Service Plotting Guidelines</i>) Voice (216) 902-6209 Internet http://www.uscg.mil/mlclant/cetc/

Organizing Concepts for Deliverables

2.1 File Types

NIH requires two types of CAD deliverable files: model and sheet files. NIH provides prototype files for the development of these files.

2.1.1 Model Files

Model files represent the building's physical layout and components such as floor plans and elevations. Model files are drawn full size in model space. Floor Plan Model files represent one floor. The attribute block is inserted on layer G-ANNO-TTLB at 0,0,0 in paper space on layout.

2.1.2 Sheet Files

Sheet files are used to assemble model files for plotting and viewing purposes. Every sheet file has a drawing area, title block, and border and represents one plotted drawing. Sheet files shall be assembled in paper space, at a 1 = 1 scale and set up to automatically plot at the largest standard scale that fits the sheet. In Autodesk Architectural Desktop, separate layout tabs may be used for plotting different sizes of the same drawing within the same sheet file. The typical multiple file approach using model and sheet files is illustrated below. Model files are externally referenced into the sheet file's model space. For the purposes of consistency and minimizing data entry NIH has developed a title block template. Use of the provided title block (see section 5.0) is required unless indicated by an Organization Supplement.

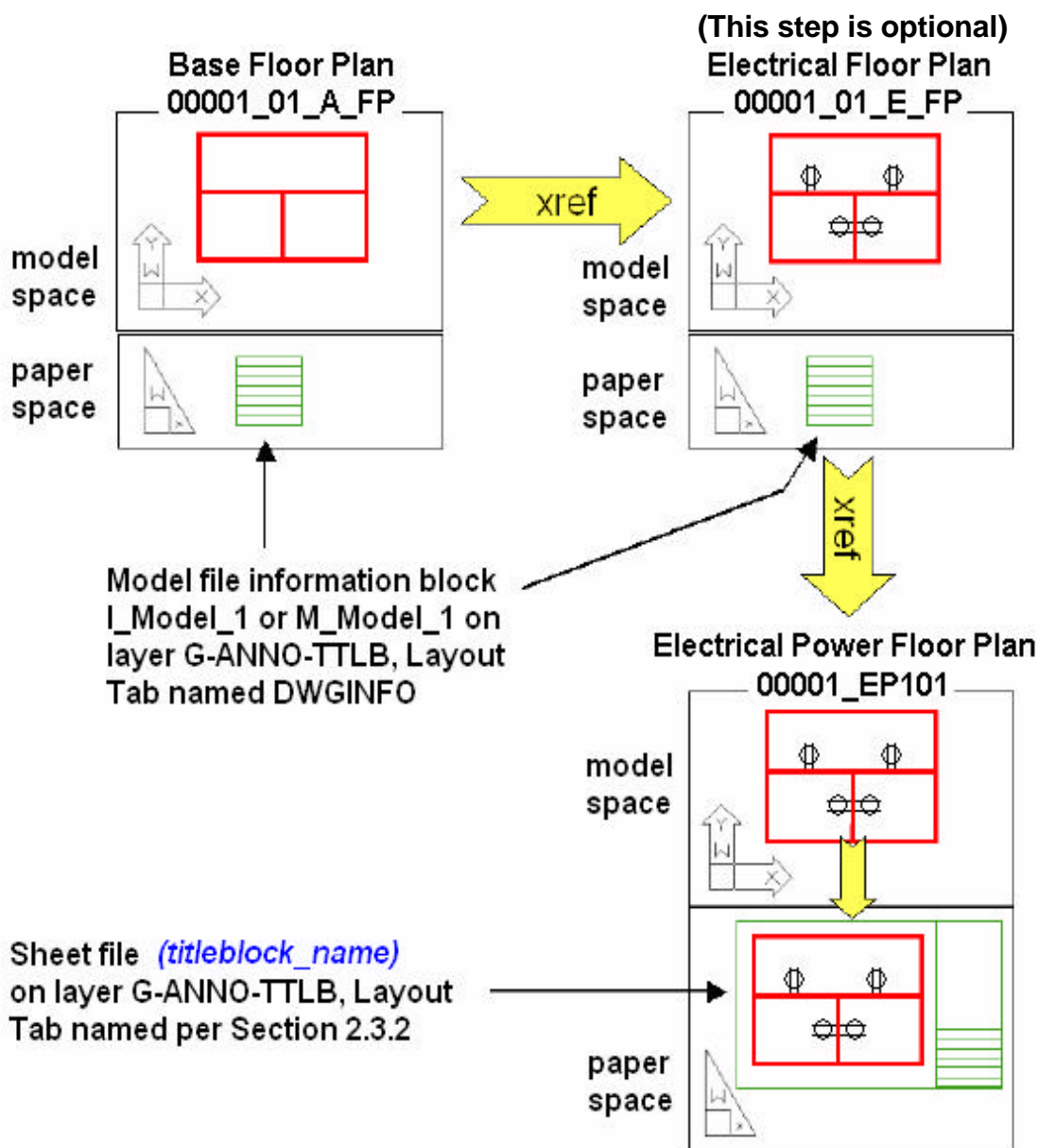
2.1.3 Prototype Files

NIH provides various prototypes for contractor use. See Section 5.0 Files for Download.

2.1.4 Drawing Assembly

The base model file is externally referenced into the discipline specific model file (if applicable) at full size in model space. The discipline specific model file is externally referenced into the sheet file at full size in model space. Viewport(s) are drawn in paper space. The drawing content is scaled through the viewport(s) and plotted at 1:1

Drawing Assembly Diagram

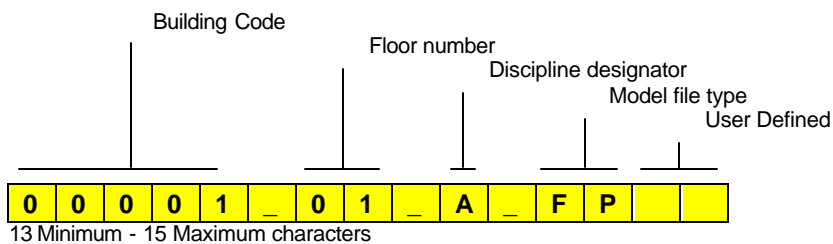


2.2 File Names

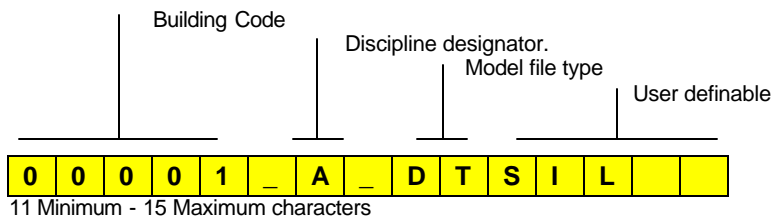
NIH uses a building code or building code and floor number as part of the long filename. NIH allows only an underscore as a placeholder in file names to facilitate data transfer to other NIH systems.

2.2.1 Model Files

Model file names consist of a five character building code and underscore, followed by a two character floor number and underscore, followed by a discipline designator and underscore, followed by a two-letter model file type. Use of a two-character user definable field is optional. In the event when the building code is less than five characters, zeros will be added preceding the building code. An example of a model file name, 00001_01_A_FP is the first floor architectural plan for building code 1.



Detail file names consist of a five character building code and underscore, discipline designator and underscore, followed by a two-letter model file type, followed by a five-character user definable field. 00001_A_DTSIL is the sill detail in the architectural plan in building 1.

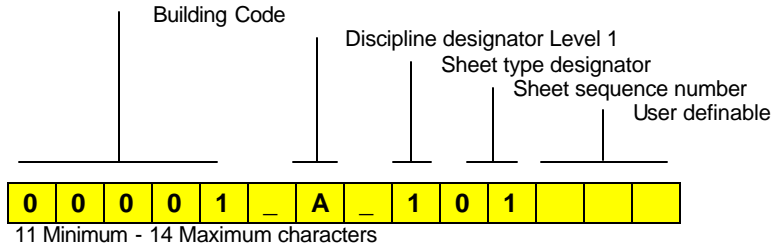


2.2.2 Model File Designators

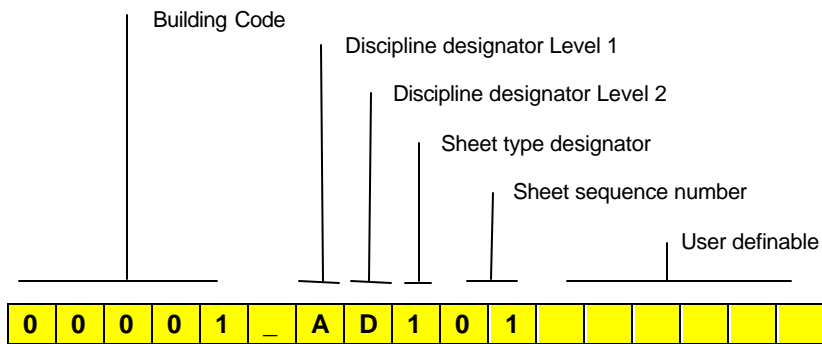
Discipline designator (two-character field with second character as an underscore)		Model file type (apply to all disciplines)			
A	Architectural	*_FP	Floor plan	*_EL	Elevation
B	Geotechnical	*_DP	Demolition plan	*_SC	Section
C	Civil	*_SP	Site plan	*_DT	Detail
D	Process	*_QP	Equipment plan	*_SH	Schedule
E	Electrical	*_XP	Existing plan	*_3D	Isometric/3D
F	Fire protection	*_RO	Roof plan	*_DG	Diagrams
G	General				
H	Hazardous materials				
I	Interiors	Model file type (discipline specific)			
L	Landscape	Civil		Fire protection	
M	Mechanical	C_EP	Environmental plan	F_KP	Sprinkler system
O	Operations (includes facility and assignment drawing)	C_UP	Utility plan	*_VP	Evacuation plan
P	Plumbing	C_GP	Grading plan		
Q	Equipment	C_RP	Road/topographic plan		
R	Resource	C_SV	Survey		
S	Structural	Structural		Plumbing	
T	Telecommunications	S_FP	Framing plan	P_PP	Plumbing plan
V	Survey/mapping	S_NP	Foundation plan		
W	Civil work				
X	Other disciplines	Architectural		Mechanical	
Z	Contractor/shop drawing	A_EP	Enlarged plan	M_CP	Control plan
	Safety	A_CP	Ceiling plan	M_HP	HVAC ductwork
	Security	A_RP	Furniture plans	M_PP	Piping plan
		A_NP	Finish plans		
Floor number					
01-99	First to 99th floor	Interiors		Electrical	
B1	Basement	I_EP	Enlarged plans	E_LP	Lighting
G1	Ground Floor	I_CP	Ceiling plans	E_PP	Power
K1	Parking	I_RP	Furniture plans	E_GP	Grounding
M1	Mezzanine	I_NP	Finish plans	E_CP	Communications
P1	Penthouse				
RX	Roof Plan A through Z	CAFM (assignment plan only)		Telecommunications	
SB	Sub_Basement	O_KY	Key drawing	T_TP	Telecommunications
		O_SR	Source drawing		
Note 1: if more than one, use increment number on mezzanines, penthouses, parking, and basements.		Note 2: floor number may not apply to all drawings, especially details			

2.2.3 Sheet Files

Sheet file names consist of the building code, followed by a discipline designator, either a single character with underscore (Level 1) or two character (Level 2); followed by the sheet type designator, followed by the sheet sequence number; usually a two-character field starting at 01 and continuing through 99. Use of a three-character user definable field is optional.



Within the two-character discipline designator, the first character is the discipline character and the second is the modifier. The modifier is used to subdivide the information for a specific use or purpose, such as project complexity, or need for specialization in intricate fields. For example 00001_AD101 would be the first architectural demolition plan in the set.



2.2.4 Sheet File Designators

Level 1	Level 2	Description of Suggested Name	Content
A		Architectural	All or any portion of subjects included in Level 2
	AS	Architectural Site	
	AD	Architectural Demolition	Protection and removal
	AE	Architectural Elements	General Architectural
	AI	Architectural Interiors	
	AF	Architectural Finishes	
	AG	Architectural Graphics	
	AJ		User Defined
	AK		User Defined
C		Civil	All or any portion of subjects included in Level 2
	CD	Civil Demolition	Structure removal and site clearing
	CS	Civil Site	Plats, dimension control
	CG	Civil Grading	Excavation, grading, drainage, erosion control
	CP	Civil Paving	Roads, driveways, parking lots
	CI	Civil Improvements	Pavers, flagstone, exterior tile, furnishings, retaining walls, and water features
	CT	Civil Transportation	Waterways, wharves, docks, trams, railways, people movers
	CU	Civil Utilities	Water, sanitary sewer, storm sewer, power, communications, fiber optic, telephone, cable television, natural gas, and steam systems
	CJ		User Defined
	CK		User Defined
W		Civil Works	All or any portion of subjects included in Level 2
	WJ		User Defined
	WK		User Defined
Z		Contractor/Shop Drawings	All or any portion of subjects included in Level 2
	ZJ		User Defined
	ZK		User Defined
E		Electrical	All or any portion of subjects included in Level 2
	ES	ES Electrical Site	Utility tunnels, site lighting
	ED	ED Electrical Demolition	Protection, termination, and removal
	EP	EP Electrical Power	
	EL	EL Electrical Lighting	
	EI	EI Electrical Instrumentation	Controls, relays, instrumentation, and measurement devices
	ET	ET Electrical Telecommunications	Telephone, network, voice and data cables
	EY	EY Electrical Auxiliary Systems	Alarms, nurse call, security, CCTV, PA, music, clock, and program
	EJ		User Defined
	EK		User Defined
Q		Equipment	All or any portion of subjects included in Level 2
	QA	Athletic Equipment	Gymnasium, exercise, aquatic, and recreational
	QB	Bank Equipment	Vaults, teller units, ATMs, drive-through
	QC	Dry Cleaning Equipment	Washers, dryers, ironing, and dry cleaning
	QD	Detention Equipment	Prisons and jails

QE	Education Equipment	Chalkboards, library
QF	Food Service Equipment	Kitchen, bar, service, storage, and processing
QH	Hospital Equipment	Medical, exam, and treatment
QL	Laboratory Equipment	Science labs, planetariums, observatories
QM	Maintenance Equipment	Housekeeping, window washing, and vehicle servicing
QP	Parking Lot Equipment	Gates, ticket and card access
QR	Retail Equipment	Display, vending, and cash register
QS	Site Equipment	Bicycle racks, benches, playgrounds
QT	Theatrical Equipment	Stage, movie, rigging systems
QV	Video/Photographic Equipment	Television, darkroom, and studio
QY	Security Equipment	Access control and monitoring, surveillance
QJ		User Defined
QK		User Defined
F	Fire Protection	All or any portion of subjects included in Level 2
FA	Fire Detection and Alarm	
FX	Fire Suppression	Fire extinguishing systems and equipment
FJ		User Defined
FK		User Defined
G	General	All or any portion of subjects included in Level 2
GI	General Information	Drawing index, code summary, symbol legend, orientation maps
GC	General Contract	Phasing, schedules, contractor staging areas, fencing, haul routes, erosion control, temporary and special requirements
GR	General Resource	Photographs, soil borings
GJ		User Defined
GK		User Defined
B	Geotechnical	All or any portion of subjects included in Level 2
BJ		User Defined
BK		User Defined
H	Hazardous Materials	All or any portion of subjects included in Level 2
HA	Asbestos	Asbestos abatement, identification or containment
HC	Chemicals	Toxic chemicals handling, removal or storage
HL	Lead	Lead piping or paint removal
HP	PCB	PCB containment and removal
HR	Refrigerants	Ozone depleting refrigerants
HJ		User Defined
HK		User Defined
I	Interiors	All or any portion of subjects included in Level 2
ID	Interior Demolition	
IN	Interior Design	
IF	Interior Furnishings	
IG	Interior Graphics Murals and visuals	
IJ		User Defined
IK		User Defined
L	Landscape	All or any portion of subjects included in Level 2
LD	Landscape Demolition	Protection and removal of existing landscaping

LI	Landscape Irrigation	
LP	Landscape Planting	
LJ		User Defined
LK		User Defined
M	Mechanical	All or any portion of subjects included in Level 2
MS	Mechanical Site	Utility tunnels and piping between facilities
MD	Mechanical Demolition	Protection, termination, and removal
MH	Mechanical HVAC	Ductwork, air devices, and equipment
MP	Mechanical Piping	Chilled and heating water, steam
MI	Mechanical Instrumentation	Instrumentation and controls
MJ		User Defined
MK		User Defined
O	Operations	All or any portion of subjects included in Level 2
OJ		User Defined
OK		User Defined
X	Other Disciplines	All or any portion of subjects included in Level 2
XJ		User Defined
XK		User Defined
P	Plumbing	All or any portion of subjects included in Level 2
PS	Plumbing Site	Extension and connections to Civil Utilities
PD	Plumbing Demolition	Protection, termination, and removal
PP	Plumbing Piping	Piping, valves and insulation
PQ	Plumbing Equipment	Pumps and tanks
PL	Plumbing	Domestic water, sanitary and storm drainage, fixtures
PJ		User Defined
PK		User Defined
D	Process	All or any portion of subjects included in Level 2
DS	Process Site	Extension and connection to civil utilities
DD	Process Demolition	Protection, termination and removal
DL	Process Liquids	Liquid process systems
DG	Process Gases	Gaseous process systems
DP	Process Piping	Piping, valves, insulation, tanks, pumps, etc.
DQ	Process Equipment	Systems and equipment for thermal, electrical, materials handling, assembly and manufacturing, nuclear, power generation, chemical, refrigeration, and industrial processes
DE	Process Electrical	Electrical exclusively associated with a process and not the facility
DI	Process Instrumentation	Instrumentation, measurement, recorders, devices and controllers (electrical and mechanical)
DJ		User Defined
DK		User Defined
R	Resource	Data furnished without warrant as to accuracy
RC	Resource Civil	Surveyor's information and existing civil drawings
RS	Resource Structural	Existing facility structural drawings
RA	Resource Architectural	Existing facility architectural drawings
RE	Resource Electrical	Existing facility electrical drawings

	RM	Resource Mechanical	Existing facility mechanical drawings
	RJ		User Defined
	RK		User Defined
S		Structural	All or any portion of subjects included in Level 2
	SD	Structural Demolition	Protection and removal
	SS	Structural Site	
	SB	Structural Substructure	Foundations, piers, slabs, and retaining walls
	SF	Structural Framing	Floors and roofs
	SJ		User Defined
	SK		User Defined
V		Survey Mapping	All or any portion of subjects included in Level 2
	VA	Aerial	
	VF	Field	
	VI	Digital	
	VU	Combined Utilities	
	VJ		User Defined
	VK		User Defined
T		Telecommunications	All or any portion of subjects included in Level 2
	TA	Audio Visual	Cable, music, and CCT systems
	TC	Clock and Program	Time generators and bell program systems
	TI	Intercom	Intercom and public address systems
	TM	Monitoring	Monitoring and alarm systems
	TN	Data Networks	Network cabling and equipment
	TT	Telephone	Telephone systems, wiring, and equipment
	TY	Security	Access control and alarm systems
	TJ		User Defined
	TK		User Defined

2.2.5 Sheet Type Designators

Sheet type designator (one number field)	
0	General (symbols, legends, notes , etc.)
1	Plans (horizontal views)
2	Elevations (vertical views)
3	Sections (sectional views)
4	Large scale (plans, elevations, or sections that are not details)
5	Details
6	Schedules and diagrams
7	User defined
8	User defined
9	3D Views (isometric, perspectives, photographs)

2.3 Layout Tab Names

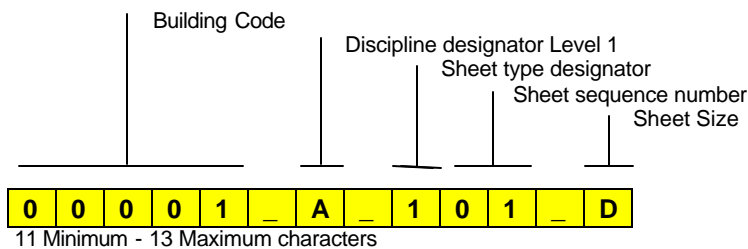
In Autodesk Architectural Desktop, layout tabs simulate a sheet of paper and provide a predictable plotting setup.

2.3.1 Model File Tab Names

Model files shall have at least one layout tab with the name of DWGINFO. The DWGINFO layout tab will have no viewport window and the model file information block. Additional layout tabs may be used for viewing and working on the building model and named appropriate for the view.

2.3.2 Sheet File Tab Names

Separate layout tabs may be used in sheet files for plotting different sizes of the same drawing within the same sheet file. Each layout tab will be named with the sheet name as described in section 2.2.3 with the user definable field being the sheet size.



2.4 Drawing Files

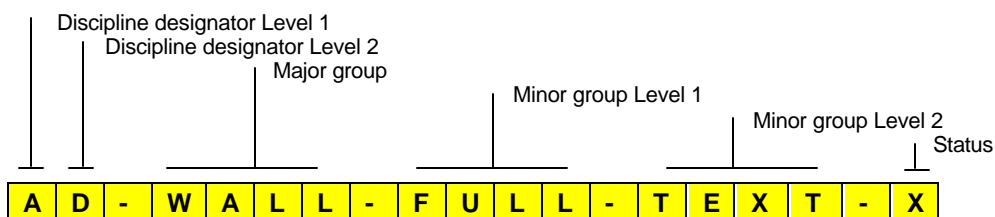
2.4.1 Layer names

NIH has adopted AIA layer naming conventions. The AIA *CAD Layer Guidelines, U.S. National CAD Standard Version 2.0* contains the AIA master layer list that contractors must follow. NIH has developed electronic templates with the most common layers for each discipline (see Section 5.0 Files for Download). The templates are available fill out and submit request for download of drawings per standard operating procedure.

<http://qualtrax.od.nih.gov/Quality/Publish/00001164.DOC?TimeStamp=38323.4444791667>

Layer names consist of four defined field groups: Discipline Designator, Major Group, two Minor Groups, and Status. The Discipline Designator and Major Group are mandatory. The Minor Groups and Status fields are optional. Each field is separated from adjacent fields by a dash ("-") for clarity.

A one or two character discipline designator followed by a four-character major group designator indicating the building system. Two four-character minor group designators may be added to further define the major group. Lastly an optional one-character status designator can be used. For example, AD-WALL-FULL-TEXT-N would be the layer for full height architectural demo wall text not in contract. Refer to section 2.2.4 Sheet File Designators for Level one and Level 2 Discipline Designators.



The AIA master layer list allows different layer names for the same information such as A-COLS, I-COLS, and S-COLS. NIH does not allow the use of duplicate names preferring that the information be placed on the layer of the discipline responsible for the information. For example, columns should always be placed on the structural layer (S-COLS), lighting should always be

placed on the electrical layer (E-LITE), and plumbing fixtures should always be placed on the plumbing layer (P-FIXT). Additional layers may be may be required for specified projects.

2.4.2 Layer Status Field Code

Layer Status Field Code	
D	Existing to demolish
E	Existing to remain
F	Future Work
M	Items to be moved
N	New work
T	Temporary work
X	Not in contract
1-9	Phase numbers

2.4.3 Layer Key Styles

Autodesk Architectural Desktop provides additional layer tools which add layer standards, layer keying, and a layer management interface, the Layer Manager, to help you standardize, automate, and manage the use of layers in your office, in your projects, and in your drawings.

Each layer key style contains a set of layer keys. You can create different sets of layer keys that you can use to place objects on defined layers in your drawings. The NIH-AIA (256 color) layer key styles contain layer keys and layer properties, including layer name, description, color, linetype, lineweight, plot style, and plot settings for all of the AEC objects. You can copy an existing layer key style and purge unused layer key styles. You can purge only those layer key styles not currently in use. Layer key styles can be imported to and exported from existing drawings and new drawings. You can import the NIH-AIA (256 color) layer key styles from file NIH_KeyLayer.dwg that is available include in your request to NIH for download.

2.4.4 Additional Drawing Requirements

Attributes - Attributes may be used to store data in the drawing. Do not use attributes to store large amounts of data (greater than 10% of drawing size) or types of data that are better stored in external databases. NIH requires the use of an attributed title block and a model file attributed block to store descriptive data about the drawings, see title blocks.

Blocks - Any graphic entity that occurs repeatedly in drawings should be made into a block. Attributes contained within a block should pertain to the current project. Insertion points for each block shall be consistent with its placement in the drawing. Use logical insertion points such as the center of a circle, bottom left corner of an object, etc. Keep names simple and descriptive. Purge all unused blocks from the drawing. Nested blocks are permitted but should be avoided whenever possible. If nested blocks are used, they must be documented on the Project and Drawing Documentation form (see Section 3 Deliverable Requirements). Draw objects used to create blocks on layer 0 so the block inherits the properties of the layer on which it is inserted. Do not insert blocks on layer 0 (zero). When submitting drawings no objects will be on layer 0 (zero) unless otherwise specified.

Dimensioning - All dimensions shall update automatically when the distance they are measuring changes (associated dimensioning). Refer to the NIH Design and Policy Guidelines for additional standards.

Drawing limits - Do not set the limits any larger than necessary to accommodate the drawing. No entities shall be located outside the drawing limits.

Drawing origin - Organize drawings in model space so that the lower left intersection of the outermost column lines that remain constant on most floors is placed at 0,0,0. In order to ensure proper insertion of xrefs and the stacking of floor plans, the origin point for an entire building must be consistent between model files. Once the origin is established, it cannot be changed. For sheet files, place the lower left corner of the sheet at 0,0,0.

Graphic standards - Drawing standards and symbology shall be in accordance with the AIA *Architectural Graphic Standards*. The *U.S. National CAD Standard* is also a good reference for drawing symbols, details, and guidelines.

Hatching - Do not use polylines with increased width for poché or hatching. All hatching shall be associative.

Key Plan - G-SITE is the layer on which the key site plan should be drawn.

Layers - Use the NIH Autodesk Architectural Desktop Layer.

Layer colors - All entities shall be assigned color by layer.

Line types - Contour lines, dashed lines, and other fonted lines shall be made of one continuous line segment, not a series of separate line segments. If line types other than standard Autodesk® Architectural Desktop line types are used the *.LIN file must be provided with the submission. Section 5.0 Files for Download includes a *.LIN file for use. Use of toned or poché lines are acceptable for distinguishing between various types of work, such as new from existing, phase 1 from phase 2, or background floor plans. Curved entities such as circles, arcs, and ellipses shall be created of one continuous line segment, the exception being entities that have to be physically constructed in a segmented fashion. These may be segmented to represent the joints in the actual construction.

Line weights - See sample line weight in Part 3.

Scale - Create drawing entities at full size. For example, a 30 meter wall will be drawn to meters and a 1 meter column will be drawn to 1 meter. Drawings considered schematic in nature can be drawn to any scale. Some examples of schematic drawings are schedules, riser diagrams, schematic diagrams, and single line diagrams.

Plan drawings - Create a separate sheet file for each drawing. Use sheet files to combine floor plans with non-plan information or multiple elevations. Do not combine several drawings such as elevations, sections, and details in one model file. When a floor plan is too large to fit on a single sheet at the desired scale use viewports in separate sheet files to show portions of the floor. DO NOT create individual model files for portions of a floor.

Title Blocks - NIH requires the use of a standardized, attributed title block for each sheet file. NIH also requires a standardized, attributed block in all model files. Templates, blocks, and instructions are listed in Section 5.0 Files for Download and are available, include in your request for download.

Text and fonts - Use only standard Autodesk Architectural Desktop or approved True Type fonts. The text styles.doc contains a list of acceptable fonts. The minimum plotted text size for all

full size drawings shall be 2.5 mm. For clarity and presentation purposes it may be necessary to use other text sizes.

Units - Metric units shall be the standard system of measurement for new facilities unless otherwise specified. Ceiling grids shall be designed per metric standards, and metric size light fixtures shall be specified. Imperial units may be used for projects in existing buildings when existing drawings are Imperial. Project scope of work will specify use of Imperial or metric units. Base units for metric shall be millimeters for imperial use inches. For projects in metric system, all dimensions and distances shall be exact multiples of ten(10) millimeters.

Xrefs - Autodesk Architectural Desktop term for external reference. Xrefs help to organize drawing information, enhance coordination, and minimize redundant data. The xref path shall not include drives or directory designations and the xref is placed on layer G-ANNO-REFR. Document the relationship between drawing file and xref on the project documentation report and deliverables matrix. See Section 4.4 Project Documentation

Reference Tables

The following tables are provided for reference purposes. They are intended to aid CAD drafters in the creation of drawings by providing standard data for text sizing, scale, and plotting.

3.1 Tables For Creating Drawings

3.1.1 Line Weight

Line weights are used to improve drawing readability. The table below shows some typical weights and their uses in construction drawings.

Line weight	Line weight	Layer name*	Description
Thin	0.18 mm/ 0.007 in.	THIN	Dimension leaders/ witness lines, dimension lines, object lines seen in the distance, and most patterns.
Medium	0.25 mm/ 0.010 in.	MEDM	Minor object lines, line terminators (arrowheads and ticks), hidden lines, and note leader lines.
Medium thick	0.35 mm/ 0.014 in.	MEDT	Most object lines, text, schedule boxes, and charts.
Thick	0.50 mm/ 0.020 in.	THIK	Minor title underlining, title text, object lines requiring special emphasis.
Extra thick	0.70 mm/ 0.028 in.	XTHK	Use sparingly for underlining titles and separating portions of drawings, elevation grade lines, building footprints, and top of grade markings.
Optional	1.00 mm/ 0.040 in.	OPTI	
			* Layer name modifier to use when layers are separated by line weights such as title blocks and details.

3.1.2 Text Height Guide

Standardized text height in drawings allows for consistent presentation and plotting. The tables below list standard plotted text heights and the corresponding drawing height for each scale.

Metric		Plotted Text Height					
Metric scale		2mm	3mm	5mm	6mm	12mm	24mm
1:200	Text Height =	400mm	600mm	1000mm	1200mm	2400mm	4800mm
1:100	Text Height =	200mm	300mm	500mm	600mm	1200mm	2400mm
1:50	Text Height =	100mm	150mm	250mm	300mm	600mm	1200mm
1:25	Text Height =	50mm	75mm	125mm	150mm	300mm	600mm
1:10	Text Height =	20mm	30mm	50mm	60mm	120mm	240mm
1:5	Text Height =	10mm	15mm	25mm	30mm	60mm	120mm
1:1	Text Height =	2mm	3mm	5mm	6mm	12mm	24mm
		Actual height of text in CAD drawing					

Imperial		Plotted Text Height						
Imperial scale		3/32"	1/8"	5/32"	3/16"	1/4"	3/8"	1/2"
1/32"=1'-0"	Text Height =	3'	4'	5'	6'	8'	12'	16'
1/16"=1'-0"	Text Height =	1'-6"	2'	2'-6"	3'	4'	6'	8'
3/32"=1'-0"	Text Height =	1'-1.5"	1'-6"	1'-8"	2'-3"	3'	4'-6"	6'
1/8"=1'-0"	Text Height =	9"	1'	1'-3"	1'-6"	2'	3'	4'
1/4"=1'-0"	Text Height =	4.5"	6"	7.5"	9"	1'	1'-6"	2'
3/8"=1'-0"	Text Height =	3"	4"	5"	6"	8"	1'	1'-4"
1/2"=1'-0"	Text Height =	2.25"	3"	3.75"	4.5"	6"	9"	1'
3/4"=1'-0"	Text Height =	1.5"	2"	2.5"	3"	4"	6"	8"
1"=1'-0"	Text Height =	1.13"	1.5"	1.875"	2.25"	3"	4.5"	6"
1 1/2"=1'-0"	Text Height =	.75"	1"	1.25"	1.5"	2"	3"	4"
3"=1'-0"	Text Height =	.38"	.5"	0.625"	.75"	1"	1.5"	2"
		Actual height of text in CAD drawing						

3.2 Tables For Plotting Drawings

3.2.1 Plotting Sheet Sizes and Scales

All NIH Projects shall use a D Size sheet as the default and preferred size.

Sheet Sizes (ANSI sizes A, B, and Architectural sizes)

Size	Horizontal dimension	Vertical dimension
D	914 mm (36")	610 mm (24")
C	610 mm (24")	457 mm (18")
ANSI B	432 mm (17") 279 mm	(11")
ANSI A	279 mm (11") 216 mm	(8½")

Acceptable Scales

For reference only for plotting model files. Full size sheet files shall be assembled in paper space and plotted at largest standard scale that fits sheet.

Architectural scales		Engineering scales		Metric scales	
Drawing scale	Plot scale	Drawing scale	Plot scale	Drawing scale	Plot scale
		1" = 5000'	60000		
		1" = 2500'	30000		
		1" = 1250'	15000		
		1" = 1000'			
		1" = 500'	6000	1:5000	5000
		1" = 200'	2400	1:2500	2500
		1" = 100'	1200	1:1250	1250
		1" = 50'	600	1:1000	1000
		1" = 40'	480	1:500	500
		1" = 30'	360		
1/16" = 1'-0"	192	1" = 20'	240	1:200	200
1/8" = 1'-0"	96	1" = 10'	120	1:100	100
1/4" = 1'-0"	48	1" = 5'	60	1:50	50
3/8" = 1'-0"	32			1:30	30
1/2" = 1'-0"	24	1" = 2'	24	1:20	20
3/4" = 1'-0"	16	1" = 2'	24	1:20	20
1" = 1'-0"	12	1" = 1'	12	1:10	10
1 1/2" = 1'-0"	8			1:10	10
3" = 1'-0"	4			1:5	5
6" = 1'-0"	2			1:2	2
Full size	1			1:1	1

3.3 Units and Conversion Guide

Comparison of Drawing Scales

Inch-foot scales	Inch-foot ratio	Metric scale
Full Size	1:1	1:1
Half Size	1:2	1:2
4" = 1'-0"	1:3	
3" = 1'-0"	1:4	1:5
2" = 1'-0"	1:6	
1-1/2" = 1'-0"	1:8	1:10
1" = 1'-0"	1:12	
3/4" = 1'-0"	1:16	1:20
1/2" = 1'-0"	1:24	1:25
1/4" = 1'-0"	1:48	1:50
1" = 5'-0"	1:60	
1/8" = 1'-0"	1:96	1:100
1" = 10'-0"	1:120	
1/16" = 1'-0"	1:192	1:200
1" = 20'-0"	1:240	1:250
1" = 30'-0"	1:360	
1/32" = 1'-0"	1:384	
1" = 40'-0"	1:480	1:500
1" = 50'-0"	1:600	
1" = 60'-0"	1:720	
1" = 80'-0"	1:960	1:1000

Conversion Factors

Quantity	From inch-pound units	To metric units	Multiply by
Length	mile	km	1.609344 *
	yard	m	0.9144 *
	foot	m	0.3048 *
		mm	304.8 *
	inch	mm	25.4 *
Area	square mile	km ²	2.59
	acre	m ²	4046.87
		ha (10000m ²)	0.404687
	square yard	m ²	0.83612736 *
	square foot	m ²	0.09290304 *
	square inch	mm ²	645.16 *

*Denotes the exact conversion.

Deliverable Requirements

4.1 Deliverable Preparation

All drawing files shall be submitted to NIH on CD or data DVD, all files shall be free of viruses using the latest version of virus cleaning and scanning software. Drawing shall be saved with index of all drawing number, file name, drawing title, including the similar information for all Xref files, and blocks used.

All drawing files shall undergo the following checks prior to submission:

Submission Checks	
1	All filenames comply
2	Verify that all entities outside the drawing limits are deleted.
3	Ensure that all blocks, layers, attributes, etc not referenced in the drawing are purged.
4	Verify that all xrefs are attached without drive or directory specifications.
5	Set the menu to the standard Autodesk® Architectural Desktop menu. (acad.mnc)
6	Scan all files for viruses.
7	Check that all unused layout tabs are deleted.
8	Ensure that the drawing settings are in accordance with Section 4.2 below.
9	All layer names comply with the AIA CAD Layer Guidelines
10	All Text styles comply
11	All linetypes comply
12	All Dimension Styles comply

Paper copies shall be provided in accordance with the A/E contract requirement.

4.2 Drawing Settings

These settings should have the file open without error and sheet files ready to plot. Autodesk Architectural Desktop commands and variables are to be set as follows.

Commands	Settings
BASE	Insertion base point (0,0,0)
GRID	Off
LAYER	Current layer is 0
LIMITS	Off, drawing limits to drawing size
LINETYPE	Current entity linetype BYLAYER; current linetype CONTINUOUS
MENU	Standard Autodesk® Architectural Desktop (acad.mnc)
POINT	Display mode 0, size 0.0
QTEXT	Off
SNAP	Off
TEXT	Style STANDARD
UCS	Set UCS to world
UCSICON	Set UCSICON to noorigin
UNITS	(linear) As appropriate for drawing
UNITS	(angular) Decimal degrees (surveyor's units for civil drawings)
ZOOM	To drawing extents

Variables	Settings
BLIPMODE	Off
ISAVEPERCENT	0, ensures every SAVE is a full SAVE
PDMODE	0, controls how point objects are displayed
PDSIZE	0, sets the display size for point objects
TILEMODE	1 (Model Space) for model files; 0 (Paper Space) for sheet files
VISRETAIN	1

4.3 Submittal media

Electronic files and documentation are due with each submittal. Paper copies shall also be provided as required by A/E contract.

4.3.1 CD-ROM Submittal

Files submitted on CD-ROM shall be write protected CD-R format. Use the Joliet file system with normal file ordering on a single track. Preserve the original file dates and enter the project number and submission stage for the CD volume label. Submit all CD's in individual jewel cases.

4.3.2 Labeling of Media

Include on all media the following:

Label with a fine point, black, permanent marker. Do not use any type of self-adhesive labels.

Include the following:

- Building number and name
- NIH project number and description
- Submission date
- Submission stage
- Disk number and sequence (if applicable)

Produce media cover (jewel case) labels that include the following:

- Building name, number, and address
- NIH project name and number provided by NIH.
- Contractor name, contact name and telephone number
- Date of submittal
- Submission stage
- Description of contents
- Disk number and sequence (if applicable)

4.4 Project Documentation

A Project Documentation Report and Deliverables Matrix must accompany all final submittals. See Section 5.0 Files for Download

Available Files

5.0 Files for Download

(Fill out and submit Request for drawings

<http://qualtrax.od.nih.gov/Quality/Publish/00001164.DOC?TimeStamp=38323.4464699074>

5.0.1 All Files for Download

All files, includes layer templates, title blocks, and other can be downloaded by filling out and submitting request for download form.